

# Astronomy 201/211 Lab #2

## Where is the Galactic Center?

### Introduction

In this lab you will make use of modern data (which you "glean" from the internet) to reproduce a classic study carried out by Harlow Shapley in the early part of the last century. Using published distances of roughly 100 globular clusters and a spreadsheet you will be able to provide evidence that we are not located at the center of the galaxy and just how far we are from the galactic center. Because you will need to look up a lot of data we suggest that you work on this with a partner. You may hand in 1 lab report between the two of you or do you own if you prefer. In either case, clearly identify who you worked with.



M 15 - the Great Globular Cluster in Pegasus (King's Observatory image)

### Procedure

1. Open a copy of the Excel spreadsheet [globular.xls](#). The process is very straight forward. The spreadsheet is protected which means you can only put data in the column reserved for the distances that you find for the globular clusters that are listed in the first column. We are using the "NGC" or New General Catalogue list of globulars. Search for these on the world wide web and find the distance that they are from earth.
2. **Careful!** Make sure that you record the distances in kilo-lightyears. If the information you have is in other units (parsecs for example) you will need to convert them. Also, be sure to save your copy of the spreadsheet program in your home folder. If the computer does not permit you to save this file try using "save as" and give the file a different name. Ask your lab instructor for help if necessary.
3. As you enter the data the graph (click on the tab Globular\_Graph) will start to fill out. This represents a plot of the X and Y coordinates of the globular clusters relative to your position in space. We are not bothering to plot the Z coordinate since we are only creating a 2D plot and are really not able to see the Z coordinate directly anyhow. When you are finished entering the data you will have a distribution that is similar to what Shapley found. Note also that as you enter the distance data, the average value for the X,Y and Z distances of globular clusters is being calculated. This will turn out to be a very important set of numbers!

### Analysis

1. Explain why you (as did Shapley) can use this data to argue that we are not located at the center of the galaxy.
2. Use the average values for the X,Y and Z coordinates to estimate the distance that we are from the galactic center. Hint: you will need to use Pythagoras' Theorem to calculate this - ask your TA for help if necessary.
3. We know that there is dust in the galaxy - especially between us and the galactic center. How will this effect your estimate for the galactic distance? (Hint - could there be some globulars that we just can't see and hence maybe our statistics have been biased?)

## What To Hand in and "Adopt a Globular"

1. In addition to discussing the two points above, I also want you to include your graph of the Globular Cluster distribution AND to select one of the globular clusters from the NGC catalogue (you choose) for further comment. Tell about the globular: how big it is, where in the sky, how old and any other neat info that you can find.
2. Prepare all of this in a neatly **type-written** and organized report and hand it in a week from Tuesday during the morning lecture period.